



## **Ivan Mikhailovich Sechenov**

1829-1905, Renowned Russian Physiologist



When Sechenov was born in 1829 little was known about neurochemistry, electrophysiology, neurons or the concept of synapses, and only a rudimentary understanding of the obvious anatomy of the brain was understood. By the end of his life he would help establish the scientific groundwork necessary to advance study in each of these areas, while waging an “uncompromising struggle against those who tried to restrict the possibilities of objective physiological study of complex manifestations in the vital activity of animals and man, including the so-called mental or psychical activity.” (p. 10 Selected Works Sechenov)

### **Early Education**

By the 1850's, Sechenov had completed a military engineer education, excelling in math, physics and chemistry. At 21, deciding he was never really interested in engineering, he elected to study medicine at Moscow University. His knowledge in mathematics, physics, chemistry and the basic physical and chemical laws set him apart as a young medical student as it would throughout his scientific career. During his studies, Sechenov developed a strong interest in the burgeoning field of physiology and after graduation left for Germany, at that time the heart of the science, to study and work in the laboratories of the most notable German physiologists of the day, including Müller, Helmholtz, Ludwig, and Bernard. Sechenov quickly gained the admiration of this prestigious group of scientists for his initiative, his independent ability to form novel ideas, and his scientifically sound method that often led to the validation his propositions. Sechenov quickly advanced from being a student of these great men, to being one of their peers. One clear proposition, however, would soon set Sechenov apart from his peers.

### **Physiology with Conscious Activity**

While most physiologists of Sechenov's day were uncovering the scientific nature of blood circulation, digestion, metabolism, respiration, homeostasis and more; they kept a clear distance from the concept of “psychical” activity, or in today's terms, conscious activity. In their view, conscious activity “could not be studied by physiological methods. Sechenov, however, asserted that this form of vital activity was, likewise, subordinated to physiological laws and should be subject to objective experimental analysis.” (p. 10, Sechenov Selected Works) Sechenov advanced this perspective in his doctoral dissertation, *The Future Physiology of Alcoholic Intoxication*, in which he expressed among other things, the “possibility of unraveling the great mystery of consciousness by means of the objective methods of science.” (p. 10, Selected Works Sechenov)

Sechenov returned to Russia in the early 1860's and successfully defended his doctoral dissertation, at the Medical and Surgical Academy in St. Petersburg. He was quickly appointed to lecture and work at the St. Petersburg academy in 1860 and soon founded one of the first physiology laboratories in Russia.

While visiting Claude Bernard's laboratory in 1862, Sechenov began a series of experiments that ultimately would prove normal reflex actions could be inhibited by stimulating areas on the spinal cord, brain stem, and higher areas in the brain. This was a breakthrough idea, because up until this point, the reflex had only been understood in terms of an action that occurred in response to a stimulus, never the absence of action (or inhibition). Sechenov began his experiments by transecting the spinal cord of a frog to expose several horizontal points. Suspending the frog by the nose, he then gently dipped one of the frogs extended toes into a mild acid solution to establish a baseline for normal reflex action. Sechenov measured reaction time by

counting the number of beats on a metronome from stimulus exposure to reflex action. Next, he chemically stimulated a point on the frog's spinal cord using salt crystal, dipped the frog's toe in the acid solution, and again measured the reflex reaction time using the metronome. Using this basic approach, Sechenov proved that spinal cord stimulation could stop a normal reflex action from occurring. In 1863, Sechenov published the first article on his early findings, "*Additional Studies on Nerve Centers that Inhibit Reflected Motion.*" In this article, in addition to his findings, he discusses the need for further investigation to determine whether the centers of the brain or muscular systems control the inhibition process, introducing for the first time the concept of non-specific cerebral systems.

Using the same basic experimental design he had developed stimulating the spinal cord in frogs, Sechenov continued his experiments to determine whether or not stimulation to the brain stem, and various higher levels of the brain would have the same impact. It did. Sechenov had proven that the central nervous system, as a mediating unit, could control whether or not a reflex action would occur. This is the basis for Sechenov's well known theory of Central Inhibition. At the urging of many, Sechenov summarized his experimental results along with the broader implications of his work in an article called, "*An Attempt to Introduce the Physiological Bases for Psychological Processes.*" Sechenov submitted his article for publication in the Russian social political magazine, *Sovremennik* (Contemporary). The official censor of the magazine rejected the article based on its title, and advised Sechenov that the article would only be included for publication if the title was changed. Sechenov changed the title to "*Reflexes of the Brain*" and it was published later in 1863 in the *Contemporary's* lower circulated sister bulletin, the *Meditinsky Vestnik* (Medical Bulletin).

### **Reflexes of the Brain**

In his article "*Reflexes of the Brain*," Sechenov proposed that psychological functions are reducible to the underlying substrate of the reflex, a physiological unit consisting of three basic components: sensory stimulation, a central conscious impression and the resulting movement. Sechenov, like Sherrington who would follow, extended the simple reflex and its actions to explain coordinated movements. The distinction between Sherrington and Sechenov, not unlike the distinction between Sechenov and his physiology peers, was that he went one step further and proposed that all mental function could be explained in the context of reflex understanding. Sechenov boldly claimed that, "all acts of conscious and unconscious life are reflexes," and further, that, human reflexes, unlike animal reflexes, can be triggered by symbolic thoughts to create automatic responses. (Reflexes of the Brain, 1863) In the face of current religious and psychological views, Sechenov's propositions were beyond an area of contemporary comfort.

Sechenov expanded and republished *Reflexes of the Brain* in book form in 1866. When it first appeared, private censors took court action, claiming that Sechenov preached a mechanistic determination that undermined the Christian notion of free will in his book. The censors further claimed that Sechenov's theories "reduced even the most human acts, without exception, to purely mechanical processes...to the level of a machine devoid of consciousness and free will. A year later, the court ruled that no action could be taken against Sechenov, because his book did not transgress any law. Implicit in the court's ruling was an essentially correct appraisal of Sechenov as a scholar who had not succumbed to the lures of antireligious philosophy and revolutionary ideology, but had instead presented his physiological studies as undiluted science." (Vucinich, p. 120)

### **A Measurable Approach to Psychology through Physiology**

The physiology community in support of Sechenov's work could see the court action claims were unfounded and based on statements taken out of context. The psychology community could not understand how anyone could reduce conscious thought to such a mechanistic perspective. As a result, a higher debate between physiology and ideological psychology began to ensue, prompting Sechenov to publish in 1873, "Who is to Elaborate the Problems of Psychology, and How?" Through his article, Sechenov argues for an overhaul of the current approach to contemporary psychology in an effort to free it from insufficient and non-substantiated theories and to bring it into the highways of science. Sechenov's answer to accomplishing this change remained

the reflex mechanism, as first presented in *Reflexes of the Brain*. He explained that the same physiological substrate used to explain and understand movements (reflexes) can be used to explain the behavior of mental actions. Both possess the same external observable aspects, sensory input, and motor response and differ only by the qualitative nature in which they are managed by the central nervous system. Anticipating the concerns that opponents might have to this basic idea, Sechenov addressed two problematic considerations in his article: “1) The case when a sensory stimulus does not result in movement and, 2) the case when movement is not preceded by any obvious sensory stimuli.” (Clover, W., p. 35) Sechenov answered the first concern using the findings of his theory of central nervous system inhibition. In effect, the act of inhibition is an action. Since inaction can be an end result of a physical process, a sensory stimulus can result without a corresponding motor response. “Further, Sechenov wrote that the ability to inhibit unwanted actions is a learned trait of maturity, one which is acquired over time, reflecting rational, mature behavior.” (Clover, W., p. 36)

In the second case, where movement is not preceded by obvious sensory input:

“Sechenov answered that the central portion of the reflex mechanism (the conscious awareness of sensation) could trigger a motor response without an initial sensory input. This occurs if the awareness of the sensory impression happens also to occur through a second, independent spinal (or cerebral) reflex. In this way any time the unconscious thought or memory of a sensation is triggered, by whatever means, its associated movement would result.

Further, the sensory events that trigger the initial reflex do not occur in isolation, but con-comitant with all the other sensations of that moment. Thus, any of these ancillary unconditioned stimuli could also elicit the resulting movement. Through the repeated co-occurrence of sensory events, independent and seemingly unrelated portions of the subject’s initial sensory environment can also produce the original response. In other words, Sechenov proposed that stimuli do not generate responses in isolation, but as one of a set of associated sensations. Thus, although, the movement may seem to have originated from a non-physical source such as the will, Sechenov contended it is more likely the case that it arose from an associated sensory event or mental trace.” (Clover, W., p. 36)

Sechenov, by connecting all action to the sensory, central nervous system, motor mechanisms of the reflex, provided the basic elements of the conditional reflex system that Pavlov later proved to be true. Sechenov acknowledged that the science of his day made it difficult to scientifically confirm many of theories he put forth. His unique background, ability and courage, however, allowed him to bravely put forth for the first time theories that bridged physiology and theoretical psychology, in the hope that those in the future would follow.

### **Sechenov’s Impact on Future Work**

Sechenov’s work helped establish an objective approach to understanding behavior and helped to establish the scientific and ideological foundation for many notable scientists to come, including Pavlov’s conditional reflex work, Vygotsky’s natural-cultural theory of psychological development, the physiological reflex feedback models advanced by Bernstein, and the Activity theory proposed by Leontiev, among others. Sechenov’s work laid the foundation for the study of reflexes, animal and human behavior, and neuroscience, neurophysiology (“Selected Physiological and Psychological Works,” Moscow, 1952). His analysis and explanation of the reflex circuit, reflex excitation and inhibition, and involuntary and voluntary action remain fundamental to understanding neuroscience today. Ivan Pavlov repeatedly stressed the motivating influence Sechenov had on his career, sharing:

“I remember my own student days as though they were yesterday. My mentor, Ivan Mikhailovich Sechenov, ‘The father of Russian physiology’, set for me the task, which has guided my life’s course, the careful study of reflexes. His text, *Reflexes of the Brain*, was very inspiring. He made what I can only call a bold attempt to apply the idea of the reflex to the activities of the hemispheres.”

Among those familiar with Sechenov’s extensive work, his historical significance is undisputed. It has been suggested the only reason he did not receive the Nobel Prize is because it was first awarded in the 1901, the year he retired. Sechenov’s contributions, which expand well beyond the scope of this brief biography, were well documented in the publications he left behind. Summarized below are some of his better known publications:

- Additional Studies on Nerve Centers that Inhibit Reflected Motion, 1863
- Physiology and the Nervous System, 1866
- Psychological Studies, 1873
- The Elements of Thought, 1881 and updated and republished in 1903
- A Scientific Activities of Russian Universities in the Natural Sciences During the Last 25 year, 1883
- Impressions and Reality, 1890
- The physiology of the Nerve Centers, 1891
- Physiological Criteria for Establishing the length of the Workday, 1894
- Physiological View of Subjective Thinking, 1894
- A Survey of Manual and Other Work Movements of Man, 1901
- Autobiographical Notes, 1904

### ***Sechenov and the Future Study of Reflexes***

“Following the trail blazed by Sechenov, Pavlov staunchly and consistently advocated the objective study of higher nervous activity. Many of Sechenov’s ideas, statements, and brilliant conjectures were substantiated by Pavlov and Sherrington and corroborated by a multitude of incontestable facts.” (Sechenov Selected Works, p. 19) Fundamentally important to the Masgutova Method is Sechenov’s work relating to the reflex circuit as mediated by the central nervous system, its relationship to involuntary and voluntary action, and the necessity of reflex maturation and integration for conscious control to occur. Without Sechenov’s bold extension of the reflex mechanism to explain conscious activity the work Dr. Masgutova has brought to life would not have been possible. Pavlov, Sherrington, Vygotsky, Luria and Bernstein, in particular, would build on many of Sechenov’s ideas to advance reflex understanding well established today.

### **Credits and Further Reading:**

Clower, W., “Early Contributions to the Reflex Chain Hypothesis, Journal of the History of Neurosciences, 1998, Vol 7, No. 1, pp. 32-42

Gardner, H., Gardner, J., Classics in Psychology: I.M. Sechenov, Biological Sketch and Essays, Arno Press, New York, 1973

Sechenov, I. M., “Biographical Sketch and Essays,” Moscow, 1935

Sechenov, I. M., “Selected Physiological and Psychological Works,” Translated from Russian by S. Belsky, Moscow, 1952

Sechenov, I. M., “Reflexes of the Brain: an attempt to establish the physiological basis for psychological processes,” Translated from Russian by S. Belsky, The Massachusetts Institute of Technology (M.I.T.) Press, 1965

Sechenov, I. M., “Russian Monographs on Brain and Behavior: Autobiographical Notes,” Translated from Russian by Kristan Hanes, American Institute of Biological Sciences, Washington D.C., 1965

Vucinich, A., “Science in Russian Culture,” 1971